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13. ABSTRACT *(Maximum 200 words)*

This grant from the Air Force Office of Scientific Research supported research in Sensor Management related to the IMA 1993-94 academic year program "EMERGING APPLICATIONS OF PROBABILITY". It provided partial support for residency of Keith Kastella, an industrial researcher at Unisys Government Systems, to pursue research on the use of discrimination gain optimization for sensor management in Air Traffic Control, Manufacturing, Robotics, Remote Sensing and Defense Applications.

Grant AF/F49620-94-1-0275 supported the publication of a technical research report submitted by Dr. Kastella for inclusion in the IMA Preprint Series. This paper has been submitted to the IEEE Transactions on Systems, Man and Cybernetics.

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The following manuscript has been submitted to the refereed journal *IEEE Transactions on Systems, Man, and Cybernetics.* It will be published in the IMA Preprint Series:

1288 **Keith Kastella**, "Discrimination Gain to Optimize Detection and Classification."

ABSTRACT: A method for managing agile sensors to optimize detection and classification based on discrimination gain is presented. Expected discrimination gain is used to determine threshold settings and search order for a collection of discrete detection cells. This is applied in a low signal-to-noise environment where target-containing cells must be sampled many times before a target can be detected or classified with high confidence. The goal of sensor management is interpreted to be to direct sensors to optimize the probability densities produced by a data fusion system that they feed. The use of discrimination is motivated by its interpretation as a measure of the relative likelihood for alternative probability densities. This is studied in a problem where a single sensor can be directed at any detection cell in the surveillance volume for each sample. Bayes rule is used to construct a recursive estimator for the cell target probabilities. The expected discrimination gain is predicted for each cell using its current target probability estimates. This gain is used to select the optimal cell for the next sample. For thresholded data, the expected discrimination gain depends on the threshold which is selected to maximize the gain for each sample. The expected discrimination gains can be maintained in a binary search tree structure for computational efficiency. The computational complexity of this algorithm is proportional to the height of the tree which is logarithmic in the number of detection cells. In a test case for a single 0 dB Gaussian target, the error rate for discrimination directed search was similar to the direct search result against a 6 dB target.